

Remarks

Claims 17, 20-31 and 41-42 stand rejected under 35 U.S.C. §112, second paragraph as being indefinite. The Applicants note with appreciation the Examiner's helpful comments with respect to the ranges of the polyamide and polyphenylene sulfide. The Applicants have amended both of Claims 17 and 20 to cure any apparent confusion or appearance of overlap. Thus, in Claim 17, the polyamide resin is present in an amount of 60 to 70% and the amount of polyphenylene sulfide resin is present in an amount of 30 to 40%. Similarly, Claim 20 has been amended to recite 75 to 95% polyamide resin and 5 to 25% polyphenylene sulfide resin. Claims 41 and 42 have been cancelled, thereby rendering that portion of the rejection moot. Withdrawal of the rejection is respectfully requested.

Claims 17, 20-31 and 41-42 stand rejected under 35 U.S.C. §112, first paragraph. The Applicants again note the Examiner's specific comments with respect to Claim 17 and 20. They have been amended to include the subject matter of Claims 41 and 42, respectively. Claims 41 and 42 have been cancelled, thereby rendering that portion of the rejection moot. Applicants enclose a chart showing support for independent Claims 17 and 20. Withdrawal of the rejection is accordingly respectfully requested.

Claims 17, 20 and 41-42 stand rejected under 35 U.S.C. §102 or, alternatively, §103 over Akhtar. Claims 41 and 42 have been cancelled as noted above. The Applicants note the Examiner's frank acknowledgment that Akhtar does not explicitly describe the melt viscosity ratio of the two polymers. Nonetheless, the rejection essentially takes the position that such melt viscosity ratios would be inherently present given the similar polymer amounts and morphologies as set forth in the rejection.

The Applicants respectfully submit that the melt viscosity ratios of Akhtar are, in fact, quite different. Details are set forth below. In that regard, the rejection takes the position that "it is noted that Applicants' show the MFR value of PPS-2 (Table 1 in Specification), while Akhtar shows the shear viscosity of PPS in Figure 2. Both of them are not melt viscosities." However, the "shear viscosity" in Fig. 2 of Akhtar is a "melt viscosity" when sheared in a capillary rheometer. Thus, "shear viscosity" in Fig. 2 is a "melt viscosity." In Fig. 2 it is shown that the shear viscosities of PPS are higher than the shear viscosities of polyamide at a shear Rate of 100s^{-1} which is a condition tested by the Applicants. This means that the melt viscosity ratio of polyamide/PPS is less than 1.0. That

is, of course, outside of the Applicants' claimed range.

Thus, the Applicants respectfully submit that they have established that the melt viscosity ratios of Akhtar are less than the melt viscosity ratios claimed by the Applicants. Therefore, the Applicants respectfully submit that both of §§102 and 103 are inapplicable to those rejected claims based on Akhtar. There is no disclosure of the Applicants' claimed melt viscosity ratio and no disclosure as to how such claimed viscosity ratios could or would be achieved from the Akhtar disclosure. As a consequence, the Applicants respectfully submit that Akhtar is inapplicable. Withdrawal of the rejection is respectfully requested.

Claims 17, 20-24 and 41-42 stand rejected under 35 U.S.C. §102 over Selby. Claims 41 and 42 have been cancelled, thereby rendering that portion of the rejection moot. The rejection is essentially based on the proposition that Selby appears to disclose blends of PPS and polyamide having the Applicants' claimed volume ratio ranges. However, the Applicants respectfully submit that this is not the case. In that regard, the Applicants note that the specific gravity of PPS equals 1.4. On the other hand, the specific gravity of polyamide equals 1.0. Thus, the range of the volume ratio of polyamide/PPS in Selby is calculated as 0.1 to 41.7/99.9 to 58.3. It can readily be seen that these ratios are outside of the Applicants' claimed range. Moreover, the Applicants respectfully submit that the Selby range is well outside of the Applicants' claimed range. Withdrawal of the rejection based on Selby is respectfully requested.

Claims 17, 20-21 and 41-42 stand rejected under 35 U.S.C. §102 or §103 over Takagi. Claims 41 and 42 have been cancelled, thereby rendering that portion of the rejection moot. The Applicants note that this rejection is also based essentially on inherency propositions based on a "reasonable basis to believe" certain aspects of the Takagi disclosure such as, for example, the melt viscosity ratios would be present. It is not possible to show or to demonstrate factually whether the blends of Takagi are in the scope of the solicited claims because the ratio of melt viscosity is not disclosed by Takagi. Nonetheless, those skilled in the art can reasonably expect that the resin blends of Takagi are not within the scope of the claims because Takagi does not consider the ratio of melt viscosity of the polyamide and the PPS.

In any event, the Applicants note that Claims 17 and 20 specifically recite that the component present in the least amount, namely the polyphenylene sulfide, is in a continuous matrix phase or a laminar phase. As is well known to those skilled in the art, when resins blend, the component

present in the larger amount forms a continuous matrix phase and the component present in the lesser amount forms a disperse particle phase. However, in this case, irrespective of the manner in which they are blended (which is not claimed and need not be claimed), the fact is that the component found in the lesser amount forms a continuous phase in the case of Claim 17 and forms a laminar disperse phase in the case of Claim 20. Those skilled in the art would readily and ordinarily expect for such a component present in a lesser amount to form a disperse particle phase. This is factually demonstrated in the enclosed excerpt from the article Journal of Applied Polymer Science, Vol. 54, 1613, 1623 (1994), on page 1613 in the left hand column.

As noted above, it is not necessary that the Applicants claim the method of achieving the continuous phase for the lesser component or the laminar disperse phase so long as they disclose methodology in their Specification that allows one skilled in the art to practice that claimed subject matter. The Applicants have clearly done that repeatedly through the many examples present in the Applicants' Specification.

As a consequence, the Applicants respectfully submit that they have more than adequately provided disclosure to produce their resin structures containing components present in a lesser amount that form a continuous phase as recited in Claim 17 or a laminar disperse phase as recited in Claim 20 and, coupled with the well known expectation with respect to resins that the component present in the larger amount forms a continuous matrix phase and the component present in a lesser amount forms a disperse particle phase, the Applicants have clearly distinguished over Takagi under both of §§102 and 103. Withdrawal of the rejection is respectfully requested.

Claim 17, 20-22 and 41-42 stand rejected under 35 U.S.C. §102 over Ono. Claims 41 and 42 have been cancelled, thereby rendering that portion of the rejection moot. This rejection is based on similar propositions as set forth above with respect to Takagi. Again, the Applicants are not in a position to demonstrate whether the Ono blends are within the scope of the solicited claims because the ratio of melt viscosity is not disclosed even though the amount of the ratio of the resin composition is disclosed. Nonetheless, based on knowledge well known to those skilled in the art, the resin blends of Ono have a morphology of a substantially uniform dispersion. This is supported by the fact that Ono has an objective of providing excellent impact strength resistance. Resin blends having a morphology of uniform dispersions ordinarily have high impact strength resistance. Thus, the Applicants respectfully submit that one skilled in the art readily expects that a resin structure

having a component present in a lesser amount that forms a continuous phase as recited in Claim 17 and as a resin component present in a lesser amount that forms a laminar disperse phase is in no way disclosed by Ono. Withdrawal of that rejection is also respectfully requested.

Claims 17, 20-22 and 41-42 stand rejected under 35 U.S.C. §102 or alternatively §103 over Deguchi. Claims 41 and 42 have been cancelled, thereby rendering that portion of the rejection moot. The Applicants note with appreciation the Examiner's detailed comments concerning Deguchi and the reliance on inherency for various of the propositions in the rejection applying Deguchi to the rejected claims. The Applicants respectfully submit that Deguchi is inapplicable.

Although it may be possible that an example composition in Deguchi having a 50% polyamide component and a 50% PPS component has a similar morphology, that example is outside of the range of components set forth in Claim 17 and 20. Thus, a 50/50% thermoplastic resin of the Deguchi example is outside of the closest range of 60/40% of Claim 17 and even further afield from the 75/25% range of Claim 20. Therefore, the Applicants respectfully submit that Deguchi is completely inapplicable. Withdrawal of the rejection based on Deguchi is respectfully requested.

The Applicants also note the Examiner's comments concerning the "particle disperse phase." In that regard, the rejection notes that such "particle disperse phase" described in the Applicants' Specification appears to refer to inorganic particles. However, the Applicants respectfully submit that the "particle disperse phase" referred to by the Applicants actually means a dispersion phase of PPS particles, not inorganic particles. Thus, the Applicants respectfully submit that Deguchi is, indeed, inapplicable. Withdrawal of the rejection is respectfully requested.

In light of the foregoing, the Applicants respectfully submit that the entire Application is now in condition for allowance, which is respectfully requested.

Respectfully submitted,



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The Effect of Viscosity Ratio on the Phase Inversion of Polyamide 66/Polypropylene Blends

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SYNOPSIS

The rheological properties of the blend components are an important parameter in the formation of a blend morphology. The effect of viscosity ratio on the morphology of polyamide 66/polypropylene blends was studied, with primary attention to the phase-inversion behavior and the average particle size of the dispersed phase. The relationship between the mechanical properties and the phase-inversion composition was investigated as well. Noncompatibilized and compatibilized blends having five different viscosity ratios were prepared by twin-screw extrusion. Maleic anhydride-grafted polypropylene was used as the compatibilizer to increase the adhesion between the two polymers and to stabilize the blend morphology. Investigation of the morphology of the blends by microscopy (SEM and TEM) showed that the smaller the viscosity ration (η_{PA}/η_{PP}) the smaller was the polyamide 66 concentration at which the phase inversion took place and that polyamide 66 became the continuous phase. The results are in accord with the model of Jordhamo. The compatibilizer induced a sharp reduction of particle size, but did not have a major effect on the phase-inversion point. The tensile and impact properties of the compatibilized blends were found to correlate with the phase inversion. An improvement in the mechanical properties was observed when polyamide 66 provided the matrix phase. © 1994 John Wiley & Sons, Inc.

INTRODUCTION

The morphology strongly affects the macroscopic properties of a blend, which means that it is important to control the size and shape of the dispersed phase. The morphology of immiscible polymer blends is created during mixing and is affected by the blending conditions, interfacial tension between the components, specific interactions such as possible covalent or hydrogen bonding, and the viscosity ratio of the components.¹⁻³

Normally, the major component forms the continuous phase.⁴ When the volume fraction of the dispersed phase is increased, the average particle size increases as well. At approximately 50/50 composition, co-continuity of the two phases is observed. In addition to the composition, the phase-inversion point also depends on the viscosity of the compo-

nents under the conditions of blending. The component with the lowest viscosity tends to form the continuous phase.⁵

The dependence of the morphology on the ratio of the viscosity of the dispersed phase to the viscosity of the matrix ($\beta = \eta_d/\eta_m$) has earlier been investigated by Wu,⁶ who studied the droplet deformation and breakup for blends of polyamide or poly(ethylene terephthalate) with ethylene-propylene elastomers. He found that the relative influence of interfacial tension and viscosity ratio on phase morphology dimensions can be characterized with a dimensionless Weber number:

$$We = \frac{\eta_m \dot{\gamma} r}{\gamma_{12}} = 4 \left(\frac{\eta_d}{\eta_m} \right)^{+0.24} \quad (1)$$

where $\dot{\gamma}$ is the shear rate, r , the radius of the dispersed particle; and γ_{12} , the interfacial tension. The exponent is positive if the viscosity ratio η_d/η_m is > 1 and negative if the viscosity ratio is < 1 . The diameter of the dispersed particles at equilibrium is

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PP-g-MAH maleic anhydride-grafted polypropylene
SEM scanning electron microscopy
TEM transmission electron microscopy

Symbols

P viscosity ratio
 r radius of the particle (m)
 We Weber number
 $\dot{\gamma}$ shear rate (s^{-1})
 $\dot{\gamma}_d$ shear rate of the dispersed phase (s^{-1})
 $\dot{\gamma}_m$ shear rate of the continuous phase (s^{-1})
 γ_{12} interfacial tension (mN/m)
 η_i viscosity of the polymer i (Pas)
 η_d viscosity of the dispersed phase (Pas)
 η_m viscosity of the continuous phase (Pas)
 ϕ_d volume fraction of the dispersed phase
 ϕ_m volume fraction of the continuous phase

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Phase Structures	Claims			Examples		
	Claims	PA/PPS Range of Component	PA/PPS Viscosity Ratio	Examples	PA/PPS Component Ratio	PA/PPS Viscosity Ratio
PPS Continuous	Claim 17	60-75/40-25 vol%	4.7-10	1	70/30	5.5
		60-75/40-25 vol%		4	70/30	4.7
				7	70/30	5.5
				10	70/30	4.7
				13	65/35	7
				17	65/35	9.5
				18	60/40	10
PPS Laminar Disperse	Claim 20	60-95/40-5 vol%	1.1-5.5	3	90/10	5.5
		60-95/40-5 vol%		9	75/25	1.6
				15	75/25	1.1
				20	70/30	1.1